ASHRAE Releases Infectious Disease Transmission Guidance

Do you know if you have fine fiber media?
Fine Fiber Filters will reduce chances of several airborne diseases.

ASHRAE Position Document on

Airborne Infectious Diseases

Approved by ASHRAE Board of Directors
June 24, 2009

American Society of Heating, Refrigerating and Air-Conditioning Engineers
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Phone: 404-636-8400 Fax 404-321-5478 www.ashrae.org
The photo shows coarse fiber/electret media magnified 400 times. Coarse/electret fibers, because of their large size, are easier and less expensive to produce. Their primary effect of particle capture requires a charge imparted on the fiber during the manufacturing process. As the charge dissipates because of particulate loading, so does the efficiency of the filter. This is critical condition, as 98% of all particles are under 1 micron in size – the range where these types of filters suffer critical loss of efficiency.

Contact Meyer Global Filters for a life cycle cost analysis
David Meyer
Cell: 661-803-5341
Email: meyerwei@cs.com

Synthetic MERV 13 Fibers (400X Magnification)

99% of all particles are under 1-micron in size, which filter would you like to see in your HVAC system?

Hi-FLO® MERV 13 Fibers (400X Magnification)
ASHRAE’s position at the present is:

• Many infectious diseases are transmitted through inhalation of airborne infectious particles termed droplet nuclei,
• Airborne infectious particles can be disseminated through buildings including ventilation systems,
• Airborne infectious disease transmission can be reduced using dilution ventilation, specific in-room flow regimes, room pressure differentials, personalized and source capture ventilation, filtration, and UVGI.

ASHRAE should commit to improving the health of individuals who occupy buildings and should support further research on engineering controls to reduce infectious disease transmission.

Issue

The potential for airborne transmission of disease is widely recognized although it generates much controversy and discussion for example which diseases are spread via the airborne route or via other mechanisms of dissemination. Three issues are pertinent for engineers:

• the impact of ventilation on disease transmission,
• the disease for which ventilation is important for either transmission or control,
• the control strategies are available for implementation in the buildings of interest.

This position paper addresses each of these.
Implications for Engineers

ASHRAE has a long tradition of relying on United States public health agencies as the cognizant authorities on public health, more recently including international health agencies and following those recommendations. It does not generally rely on its own interpretations of the health literature. ASHRAE’s role and the purpose of this Position Document is to use the health science, combined with engineering principles and practices to identify how ASHRAE programs, publications and research can better address the proper design and operation of HVAC system to prevent the spread of disease through airborne transmission.

Droplet nuclei particles may be transported through ventilation systems, as has been documented for tuberculosis, Q-fever, and measles (Li et al., 2007). If influenza transmission occurs not only through direct contact or large droplets, as is the long-standing public health tradition, but also through the airborne route, as newer data suggest, HVAC systems may contribute far more both to transmission of disease and, potentially, to reduction of transmission risk. In the absence of controlled intervention trials, this remains of great interest but of undetermined value.

Some biological agents potentially used in terrorist attacks may be purposefully transmitted through HVAC systems, such as small pox, plague pneumonia, and hemorrhagic viruses. The addition of highly efficient particle filtration to central ventilating systems is likely to reduce the airborne load of infectious particles. This control strategy may prevent the transport of infectious agents from one area, such as patient rooms in hospitals or lobbies in public access buildings, to other occupied spaces, when these areas share the same central ventilation system. Such systems are common in buildings in the U.S. Additionally, local efficient filtration units (either ceiling mounted or portable) reduce local airborne loads and may serve purposes in specific areas such as healthcare facilities or high-traffic public occupancies (Miller-Leiden et al 1996; Kujundzic et al. 2006).  

1 Filter efficiency varies with particle size, so the type of filtration required in order to be effective will vary with the type of organism and the aerosol that carries it. ASHRAE Standard 52.2 describes a minimum efficiency reporting value (MERV) for filter efficiency at various particle sizes and HEPA filtration may not be necessary. Specific personnel safety procedures may be required when changing filters, depending on the types of organisms and other contaminants that have been collected on the used media.

Recommendations

ASHRAE holds a strong position that engineers play a key role in reducing disease transmission that occurs in buildings.

ASHRAE recommends that
• a strategic research agenda be developed to address the role of HVAC systems in the spread of infectious disease; this topic be included in ASHRAE’s future strategic plans;
• further research be conducted to understand how reducing the energy footprint of buildings will impact infectious disease transmission;
• further research be conducted on engineering controls to reduce infectious disease transmission. Table 2 summarizes the control strategies available and the occupancy categories in which these controls can be used. The research priority for each control is provided. Filtration and UVGI controls research are given top priority because less is known about how these controls can be applied in buildings and HVAC systems to decrease disease events.

ASHRAE should commit to improving the health of individuals that occupy buildings and to reduce the risk of airborne infectious disease transmission.
<table>
<thead>
<tr>
<th>Disease</th>
<th>Organism</th>
<th>Clinical Manifestations</th>
<th>Healthcare/personal care workers at risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenovirus</td>
<td>Adenovirus</td>
<td>Rhinitis, pharyngitis, malaise, rash, cough</td>
<td>All, especially those in intensive care units, long-term pediatric care facilities and ophthalmology clinics</td>
</tr>
<tr>
<td>Influenza*</td>
<td>Influenza virus</td>
<td>Fever, chills, malaise, headache cough, coryza, myalgias</td>
<td>All, especially physicians and nurses</td>
</tr>
<tr>
<td>Measles (Rubella)*</td>
<td>Rubeola virus</td>
<td>Fever, rash, malaise, coryza, conjunctivitis, Koplik's spots, adenopathy, CNS complications</td>
<td>All</td>
</tr>
<tr>
<td>Meningococcal disease</td>
<td>Neisseria meningitides</td>
<td>Fever, headache, vomiting, confusion, convulsions, petechial rash, neck stiffness</td>
<td>Emergency medical personnel, emergency department staff</td>
</tr>
<tr>
<td>Mumps*</td>
<td>Mumps virus</td>
<td>Painful/swollen salivary glands, orchitis, meningoencephalitis</td>
<td>All, especially pediatricians, dentists, daycare workers</td>
</tr>
<tr>
<td>Pertussis</td>
<td>Bordetella pertussis</td>
<td>Malaise, cough, coryza, lymphocytosis, &quot;whooping&quot; cough</td>
<td>All</td>
</tr>
<tr>
<td>Parvovirus B19</td>
<td>Parvovirus B19</td>
<td>Rash, aplastic anemia, arthritis, myalgias</td>
<td>All, especially nurses</td>
</tr>
<tr>
<td>Respiratory Syncitial Virus</td>
<td>RSV</td>
<td>Often asymptomatic; respiratory symptoms</td>
<td>All</td>
</tr>
<tr>
<td>Rubella</td>
<td>Rubella virus</td>
<td>Fever, malaise, coryza, rash</td>
<td>All</td>
</tr>
<tr>
<td>Tuberculosis*</td>
<td>Mycobacterium species</td>
<td>Fever, weight loss, fatigue, night sweats, pulmonary disease, extra pulmonary involvement including lymphatic, genitourinary, bone, meningeal, peritoneal, miliary</td>
<td>All, especially nurses, pathologists, laboratory workers, housekeeping staff</td>
</tr>
<tr>
<td>Varicella</td>
<td>Human Herpesvirus 3</td>
<td>Chickenpox or zoster presentation</td>
<td>All</td>
</tr>
</tbody>
</table>

*Infections for which airborne, i.e., droplet nuclei, transmission has been documented
Table 2. Airborne Infectious Disease Engineering Control Strategies: Occupancy Categories Applicable for Consideration and Research Priorities*

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Occupancy Categories Applicable for Consideration**</th>
<th>Research Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dilution Ventilation</td>
<td>All</td>
<td>9</td>
</tr>
<tr>
<td>Personalized ventilation</td>
<td>1, 4, 6, 9, 10</td>
<td>8</td>
</tr>
<tr>
<td>Source capture</td>
<td>1, 2, 8, 14</td>
<td>10</td>
</tr>
<tr>
<td>Central system filtration</td>
<td>All</td>
<td>4</td>
</tr>
<tr>
<td>Local air filtration</td>
<td>1, 4, 6, 7, 8, 10</td>
<td>5</td>
</tr>
<tr>
<td>Upper room UVGI</td>
<td>1, 2, 5, 6, 8, 9, 14</td>
<td>1</td>
</tr>
<tr>
<td>In-room UVGI</td>
<td>1, 2, 7, 8, 14</td>
<td>3</td>
</tr>
<tr>
<td>Duct UVGI</td>
<td>1, 2, 3, 4, 5, 6, 8, 9, 14</td>
<td>2</td>
</tr>
<tr>
<td>In-room flow regimes</td>
<td>1, 6, 8, 9, 10</td>
<td>7</td>
</tr>
<tr>
<td>Differential pressurization</td>
<td>1, 2, 7, 8, 11, 14</td>
<td>6</td>
</tr>
</tbody>
</table>

**Occupancy Categories
1. Health Care (Residential and Outpatient)
2. Correctional Facilities
3. Educational < age 8
4. Educational > age 8
5. Food and Beverage
6. Internet Café / Game Rooms
7. Hotel, Motel, Dormitory
8. Residential Shelters
9. Public Assembly & Waiting
10. Transportation Conveyances
11. Residential Multi-Family
12. Retail
13. Sports
14. Laboratories where infectious diseases vectors are handled.

*Note: In considering going beyond requirements that include codes and standards, planners may use guidance from published sources such as CDC 2005, AIA 2006, APIC 2008, Table 3 above, and discuss risk with the facility user. HVAC system designers can assist closely allied disciplines such as architects and plumbing engineers to understand how unplanned airflow can impact airborne infectious disease transmission. Examples include wastewater drains, especially if improperly trapped; and wall and door leakage, including the pumping action of swinging doors.
The Appendix was developed because filter users and committee members recognized that the method in the original version of 52.2 might not have reflected actual filter performance when placed in an air handling system. In fact, the 1999 version stated, “Some fibrous media air filters have electrostatic charges that may either be natural or imposed upon the media during manufacturing. Such filters may demonstrate high efficiency when clean and drop in efficiency during their actual use cycle. The initial conditioning step of the dust-loading procedure described in this standard may affect the efficiency of the filter, but not as much as would be observed in actual service. Therefore, the minimum efficiency during test may be higher than that achieved during actual use.
The Durafil® 2V provides high-efficiency performance in a compact, energy-efficient design. Integrity of rigid minipleat performance in an energy saving lightweight design.

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**V-Bank Box Filters - High Capacity V-style High Efficiency**

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- Is available in three standard efficiencies
- Media is water-resistant. Includes glass filament separators to ensure uniform airflow throughout the media pack
- Incorporates a unique sealant channel ensuring media pack-to-frame bonding to prevent air bypass
- Includes a high-strength, impact-resistant plastic enclosing frame with modular plastic media pack supports, ensuring a rigid and durable filter
- Includes a nominal size one-inch header for added stability and a secure fit into the filter holding mechanism. The header is an integral component of the frame and is solid on all surfaces for increased sealing integrity includes a header sealing gasket to ensure no air bypass between headers in multi-filter systems
- Is bi-directional, airflow can be in either direction
- Has a maximum recommended final pressure drop capability to 2.0” w.g. Guaranteed to 10” w.g.
- Has been qualified by Underwriters Laboratories as UL 900 - Class 2
- Includes a built-in handle for convenience during transport or installation.

The Durafil 2V is excellent for VAV systems, or any commercial, medical or industrial application where high performance and product integrity are a consideration.
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The GREENest Final Filter.

- Is available in four standard efficiencies, MERV 11, 13, 14 and 16.
- Media is water-resistant.
- Includes glass filament separators to ensure uniform airflow throughout the media pack.
- Incorporates a unique sealant channel ensuring media pack-to-frame bonding to prevent air bypass.
- Includes a high-strength, impact-resistant plastic enclosing frame with modular plastic media pack supports ensuring a rigid and durable filter.
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- Is bi-directional, airflow can be in either direction.
- Can serve systems with airflow capacities to 3,000 cfm and has a maximum recommended final pressure drop capability to 2.0” w.g. Guaranteed to 10” w.g.
- Has been qualified by Underwriters Laboratories as UL 900 - Class 2.
- Is available with dual headers.

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